Thin-film detectors, X-ray lithography deliver 4-Mbit bubble chip

Next-generation bubble memory chip is even smaller than the compatible, 1-Mbit device; set of support circuits takes care of memory system requirements.

Propelled by X-ray lithography and thin-film permalloy detectors, bubble memory chips have climbed to the 4-Mbit level.

Using X-ray lithography, Intel Corp. (Santa Clara, Calif.) has managed to reduce the periodicity between bubbles from 11.2 (for its 1-Mbit chip) to 5.6 μm and feature sizes from 1.25 to 0.75 μm. At the same time, thin-film permalloy detectors, replacing thick-film versions, nearly double the signal strength of the detected bubbles (Fig. 1).

Moreover, a novel multiplexing technique handles the outputs from the eight on-chip detectors, which is double the number used on the 1-Mbit chip. This technique, which Intel is keeping under wraps, permits the higher-density chip to fit into a 22-pin package.

The outcome of all that is the 7114, plus a complement of six support circuits. The 7114 retains the basic architecture of the 1-Mbit 7110, and all the support circuits are pin-compatible with the chips that support the 7110. Aside from a few software changes to handle the larger memory space, the upgrade is totally transparent to the system user, claims Mike Eisele, bubble memory product manager. Thus in many cases the older bubble chips can be removed from a system and new ones plugged in.

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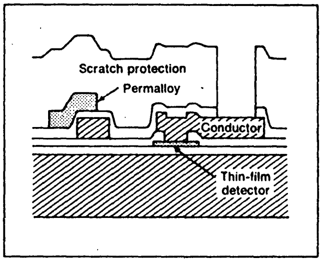
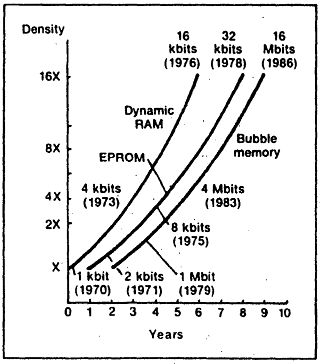
However, the support chips cannot control the 1-Mbit device, and some minor hardware changes must be made to accommodate the smaller package used for the 4-Mbit chip. The package's dimensions—1.46 by 1.35



1. A key element of Intel's 4-Mbit bubble memory is this thin-film permalloy detector structure, which delivers twice the output signal of the previously used thick-film detector.



2. Following the same growth curve as UV EPROMs and dynamic RAMs, bubble memory technology still has a good way to go to reach the 16-Mbit level projected for 1986.

in.—represent a savings of nearly 0.9 in.^{2} over the 1-Mbit package's 1.7 by 1.68 in. In addition, the smaller package, which has DIP-like pins, eliminates the need for a socket in many cases and also has a lower profile to permit board spacings as close as 0.6 in. The same package will be used by Motorola Inc. (Phoenix, Ariz.) when it builds the second-generation 1-Mbit chip as called for in the alternative-source agreement signed earlier this year with Intel (ELECTRONIC DESIGN, July 8, p. 23).

However, to bring the price of the bubble memories down to what Eisele feels would be attractive for system users—about $150 for a 4-Mbit chip by 1986—Intel has turned to a Perkin-Elmer X-ray lithography system in what it believes to be the first commercial use of X-ray systems. (Other companies, though, are not very far behind—many semiconductor manufacturers have very active research and development programs to make X-ray systems practical on the production line.)

The production process for the 4-Mbit chip includes 90% of the process steps used for the 1-Mbit device, thus sharing much of the learning-curve experience, in the short run.

Functionally, the 4-Mbit device will appear to operate just like the 1-Mbit memory. However, when the 7114 operates at the 50-kHz field rate of the 1-Mbit device, the access time is double that of the smaller chip, since the loops are longer. But the data rate is double that of the 1-Mbit chip because more detector outputs are multiplexed and then fed out from the chip. Also, a version of the 4-Mbit chip will operate at twice the field rate (100 kHz), for an access time of 41 ms—almost the 40-ms access

time of the 1-Mbit chip.

There will be a full kit of parts available from Intel when samples of the memory will be available next year. The largest chip will be the 7224 controller, which duplicates the functions of the 7220 controller but has the internal changes needed to handle the larger memory space. Similarly, the other circuits are the 7234 current-pulse generator, the 7244 formatter-sense amplifier, the 7250 coil predriver, and the 7254 coil drivers.

Bubble memory capacity has been quadrupling about every four to five years. This follows very closely what happened to UV EPROMs (Fig. 2), even though EPROMs went through doubling cycles every two years.